Polynomial Long Division

Old School Long Division: (Yes that stuff from elementary school...)

Examples:

$$\begin{array}{r} 107 \\ 25\overline{)2675} \\ -25 \\ \hline 175 \\ 175 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 82 \\ 12\overline{)993} \\ -96 \\ \hline 33 \\ -24 \\ \hline 9 \end{array} \leftarrow \text{remainder}$$

$82\ 9/12$ or $82\ 3/4$

You try:

$$\begin{array}{r} 5826 \\ 10\overline{)58260} \\ -50 \\ \hline 82 \\ -80 \\ \hline 26 \\ -20 \\ \hline 60 \end{array}$$

5,826

$$\begin{array}{r} 464 \\ 7\overline{)3248} \\ -28 \\ \hline 44 \\ -42 \\ \hline 28 \end{array}$$

464

$$\begin{array}{r} 1347\ 4/9 \\ 9\overline{)12,127} \\ -9 \\ \hline 31 \\ -27 \\ \hline 42 \\ -36 \\ \hline 67 \\ -63 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 4802 \\ 12\overline{)57628} \\ -48 \\ \hline 96 \\ -96 \\ \hline 02 \\ -0 \\ \hline 28 \\ -24 \\ \hline 4 \end{array}$$

$4,802\ 4/12$ or $4,802\ 1/3$

Polynomial Long Division: You can do the same long division process with polynomials!

Example 1:

$$\frac{27x^3 + 9x^2 - 3x - 10}{3x - 2} = 9x^2 + 9x + 5$$

We would set this problem up as

$$\begin{array}{r} 9x^2 + 9x + 5 \\ 3x - 2\overline{)27x^3 + 9x^2 - 3x - 10} \\ -27x^3 + 18x^2 \\ \hline 27x^2 - 3x - 10 \\ -27x^2 + 18x \\ \hline 15x - 10 \\ -15x + 10 \\ \hline 0 \end{array}$$

$9x^2(3x-2)$
$-(27x^3 - 18x^2) \Rightarrow -27x^3 + 18x^2$

$9x(3x-2)$
$-(27x^2 - 18x) \Rightarrow -27x^2 + 18x$

$5(3x-2)$
$-(15x - 10) \Rightarrow -15x + 10$

Example 2:

$$\frac{x^4+x^3+7x^2-6x+8}{x^2+2x+8} = x^2-x+1$$

$x^2+2x+8 \;\overline{)\; x^4+x^3+7x^2-6x+8}$

x^2-x+1

$-x^4-2x^3-8x^2$

$-x^3-x^2-6x+8$

x^3+2x^2+8x

x^2+2x+8

$-x^2-2x-8$

0

$x^2(x^2+2x+8)$

$-(x^4+2x^3+8x^2) \Rightarrow -x^4-2x^3-8x^2$

$-x(x^2+2x+8)$

$-(-x^3-2x^2-8x) \Rightarrow x^3+2x^2+8x$

$1(x^2+2x+8)$

$-(x^2+2x+8) \Rightarrow -x^2-2x-8$

Example 3:

$$\frac{27x^3+9x^2-3x-9}{3x-2} = 9x^2+9x+5+\frac{1}{3x-2}$$

$3x-2 \;\overline{)\; 27x^3+9x^2-3x-9}$

$9x^2+9x+5$

$-27x^3+18x^2$

$27x^2-3x-9$

$-27x^2+18x$

$15x-9$

$-15x+10$

1

$9x^2(3x-2)$

$-(27x^3-18x^2) \Rightarrow -27x^3+18x^2$

$9x(3x-2)$

$-(27x^2-18x) \Rightarrow -27x^2+18x$

$5(3x-2)$

$-(15x-10) \Rightarrow -15x+10$

Use polynomial division to simplify each of the following quotients.

a) $\dfrac{x^4+3x^3-x^2-x+6}{x+3}$

b) $\dfrac{2x^4-5x^3+2x^2+5x-10}{x-2}$

c) $\dfrac{7x^4-10x^3+3x^2+3x-3}{x-1}$

d) $\dfrac{2x^4+8x^3-5x^2-4x+2}{x^2+4x-2}$

e) $\dfrac{3x^4-x^3+8x^2+5x+3}{x^2-x+3}$

f) $\dfrac{3x^4+9x^3-5x^2-6x+2}{3x^2-2}$

g) $\dfrac{x^3-2x^2-4}{x-2}$

h) $\dfrac{x^3-4x^2+9}{x-3}$

i) $\dfrac{x^4-13x-42}{x^2-x-6}$